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Morphometry of the pineal gland in overweight individuals

Many scientists, e.g. Galen and Avicenna, focused their attention on the pineal gland and its functions. Descartes in his writings considered the gland as a location of the human soul. (15). Nowadays the number of scientific papers concerning the pineal gland is significantly on the rise (11). Strict scientific data concerning broad functions of the pineal gland (14) can be found. Melatonin as a gland hormone participates in many processes in the human body, e.g. circadian rhythm (9), reproduction and maturation (10), aging (5,7), mood and psychiatric disturbances (12) as well as eating disorders (1). Reports have proved a relation between the function of the gland and systemic disorders, for example hypertension (13) and structures like adrenal cortex (6). Undoubtedly there is a relation between obesity and the function of the pineal gland. Obese individuals suffer from many enzymatic disorders (2,8). The relation between the pineal gland, melatonin and obesity has recently been suggested (4). The mechanism of melatonin excretion in obese patients undergoes some changes which still remain unclear. The aim of the study was to evaluate the differences in the pineal structure in normal and overweight individuals.

MATERIAL AND METHODS

80 pineal glands from cadavers of both sexes, including 55 male and 35 female bodies (age 16 to 76 years, mean 40.81 ± 13.98) were collected. The donors did not suffer from any chronic diseases. Age, sex, weight and height of donors were measured during autopsies.

The obtained material was fixed in formalin. Pineal glands were measured and weighed using standard methods. The pineal volume was determined as spheroid by the method of Hasegawa et al. (7). The body mass index (BMI) of donors was used to evaluate their overweight or obesity. Donors were divided into two BMI-related groups. Group N consisted of normal weight individuals (BMI < 25). Group O included overweight and obese patients with BMI ≥ 25. The statistical analysis of the data was performed by means of Statistica by Statsoft. In individual groups the mean and standard deviation was used to describe the results. Levene's test was used to check the variance homogeneity. Normal distribution in groups was examined

using Shapiro–Wilk test. Normal value distribution was determined for individual groups. T-Student and Cochrane–Cox tests were used to compare the significance of differences between the groups. The level of $p \leq 0.05$ was considered statistically significant.

Table 1. Main descriptive and comparative statistical analysis of age, BMI, length (A), width (B), weight (C), AxBxC, volume and density in N and O groups. Data are expressed as mean, minimum (min.) and maximum (max.) value, standard deviation (SD)

	Group	Min.	Max.	Mean	SD	p
Age	N	16	76	40.1	14.7	0,66
	O	17	62	41.7	13.5	
BMI (kg/m^2)	N	17.9	24.5	22.31	1.54	<0.001
	O	25.2	36.6	27.39	2.44	
Length (A) (mm)	N	5.49	10.97	7884	1.260	0.17
	O	4.51	10.13	7.424	1.426	
Width (B) (mm)	N	4.90	12.25	7.212	1.257	0.03
	O	4.52	8.07	6.618	0.872	
Thickness (C) (mm)	N	2.68	17.22	4.692	2.421	0.21
	O	2.43	6.67	4.120	0.921	
Weight (g)	N	0.06	0.40	0.17	0.073	0.11
	O	0.04	0.25	0.14	0.054	
ABC (mm^3)	N	93.30	951.29	274.375	165.327	0.05
	O	56.24	443.41	209.664	84.038	
Volume (mm^3)	N	48.85	498.10	143.663	86.566	0.05
	O	29.44	232.17	109.781	44.003	
Density (g/mm^3)	N	0.0003	0.0023	0.0012	0.0004	0.69
	O	0.0007	0.0024	0.0013	0.0004	

RESULTS

The mean BMI value in O group was significantly higher ($p<0.001$) in comparison with N group. Average values in three basic measurements of the pineal glands, i.e. length (A), width (B) and thickness (C) were smaller in O group than in N group. However, only the differences in terms of width were significant ($p = 0.03$). Given the fact that the volume of the gland was determined as spheroid, it was necessary to estimate the product of three basic measurements (ABC). Both ABC and the pineal volume were significantly lower in O group (both $p=0.05$). The mean pineal weight was not significantly low in O group. Density values were similar in both groups. Table 1 shows the findings in a more detailed way. The results with $p \leq 0.05$ are presented in Figures 1–4.

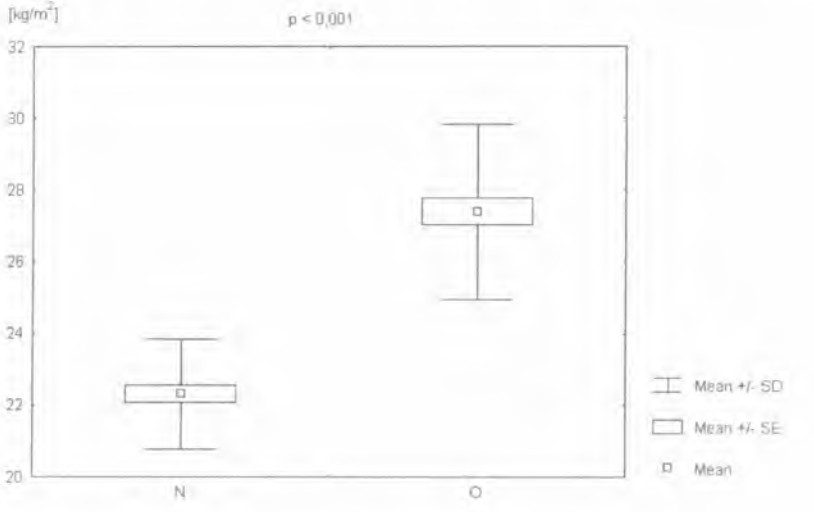

Fig. 1. Mean, standard deviation (SD) and standard error (SE) of BMI values in N and O groups. The level of $p \leq 0.05$ was accepted as statistically significant

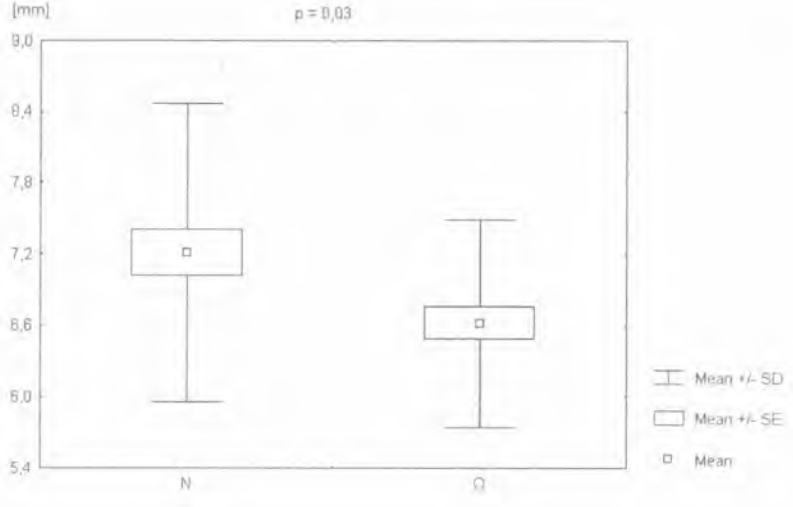

Fig. 2. Mean, standard deviation (SD) and standard error (SE) of pineal width values in N and O groups. The level of $p \leq 0.05$ was accepted as statistically significant

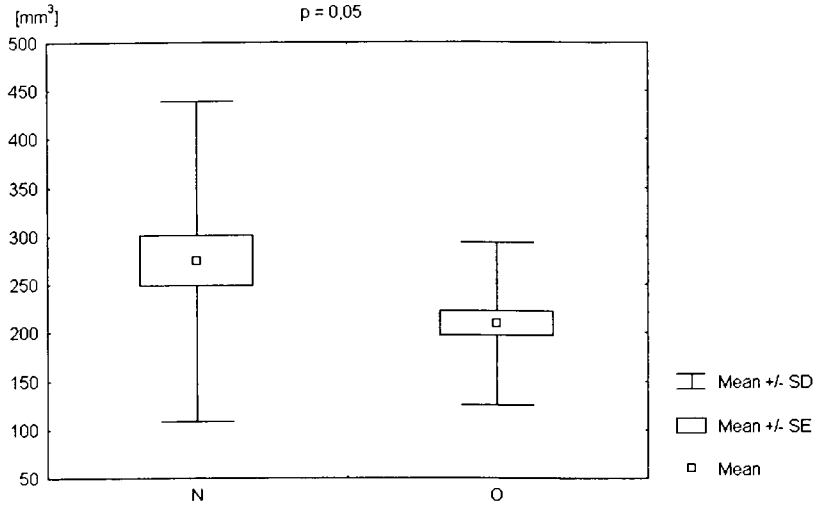

Fig.3. Mean, standard deviation (SD) and standard error (SE) of product of three basic measurements (ABC) values in N and O groups. A level of $p \leq 0.05$ was accepted as statistically significant

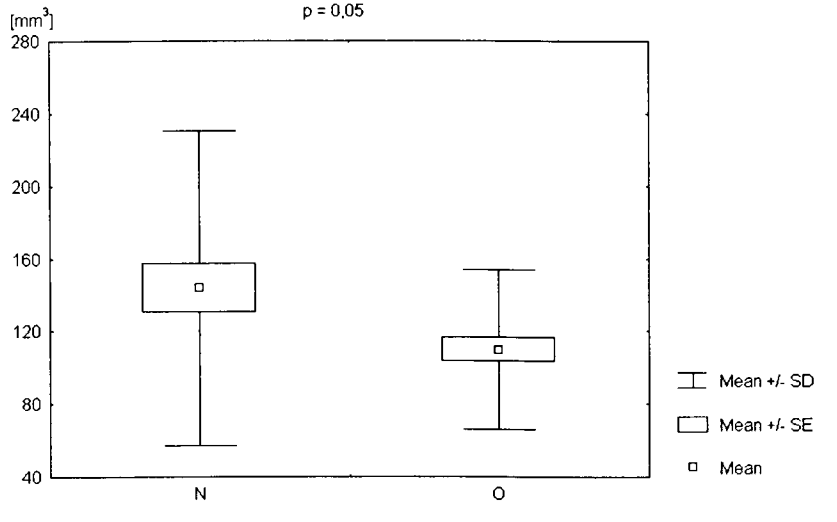

Fig. 4. Mean, standard deviation (SD) and standard error (SE) of pineal gland volume values in N and O groups. A level of $p \leq 0.05$ was accepted as statistically significant

DISCUSSION

The data concerning obesity and melatonin levels found in literature are not consistent. There are reports of a 24h plasma melatonin increase in obese patients and in patients suffering from anorexia nervosa. However, reports with no significant difference can also be found in literature. Such a discrepancy can be attributed to the fact that some patients with psychiatric disorders are obese. Most studies indicate changes of the circadian melatonin distribution rhythm e.g. attenuation of the nocturnal rise in plasma melatonin or the presence of delayed phase-shift. At present, available data about treatment in obesity (3) do not suffice to conclude the effect of melatonin on obesity. According to Hasegawa et al. (7) the pineal volume is strictly related to the grade of the pineal cyst formation. However, the results of the studies may suggest a different frequency of these structures in N and O groups. The results of our studies prove that there is a discrepancy in the pineal gland morphology in normal and overweight patients. Further studies on the effect of the pineal gland on body weight are highly recommended.

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SUMMARY

While obesity is an ever increasing problem in today's world, numerous facts suggest that its side-effects continue to be underestimated. Recent studies link obesity with pineal gland hormone and melatonin. The aim of this study was to determine differences in morphological attributes of the pineal gland in normal and overweight people in terms of pineal width and volume. A lower pineal width and volume in overweight individuals stated in the study may suggest a different excretory activity of the pineal gland.

Morfometria szyszynki u osób z nadmierną masą ciała

Otyłość stanowi wciąż narastający problem w społeczeństwach rozwiniętych, także z powodu szerokiego, wciąż niedocenianego spektrum powikłań i skutków ubocznych, jakie pociąga za sobą nadmierna masa ciała. Publikowane w ostatnim okresie prace sugerują związek otyłości z zaburzeniami funkcji szyszynki i rytmu dobowego wydzielania jej hormonu, melatoniny. Celem pracy była ocena różnic morfologicznych gruczołu u osób z prawidłową i nadmierną masą ciała. W prezentowanej pracy stwierdzono istotne statystycznie różnice w morfometrii gruczołu, mogące sugerować istnienie różnej aktywności wydzielniczej szyszynki u osób z nadwagą i otyłością w porównaniu z grupą osób o prawidłowej masie ciała.